

What is claimed is:

1. A mobile communication apparatus with multiple base station/mobile station antennas, the apparatus including a base station and at least two mobile stations, comprising:
  - 5 the base station restoring weight information and channel status information from feedback signals received from the mobile stations, determining downlink investigation information that results in maximum transmission channel capacity based on the restored weight information and channel status information, selecting mobile stations for
  - 10 simultaneous transmission from among all of the mobile stations based on the downlink investigation information, and processing data to be transmitted to the selected mobile stations based on the downlink investigation information, wherein the base station includes at least two base station antennas and each of the mobile stations includes at least
  - 15 one mobile station antenna.
2. The mobile communication apparatus of claim 1, wherein the maximum transmission channel capacity is calculated in consideration of packet fairness between the mobile stations.
- 20 3. The mobile communication apparatus of claim 1, wherein each of the mobile stations measures downlink characteristics of multiple base station/mobile station antenna channels based on pilot channel signals transmitted from the base station, determines the weight
- 25 information and channel status information based on the downlink characteristics, converts the determined weight information and channel status information into the feedback signals, transmits the feedback signals to the base station, and detects high-speed downlink shared channel (HS-DSCH) signals in units of a frame based on the downlink
- 30 characteristics, and a first control signal and data signals, which are

transmitted from the base station.

4. The mobile communication apparatus of claim 1, wherein the base station comprises:

5 a feedback information restoration unit that restores the weight information and channel status information received from each of the mobile stations through the base station antennas and outputs the restored weight information and channel status information;

a downlink investigation information generation unit that generates  
10 the downlink investigation information based on the restored weight information and channel status information in an investigation section prior to packet transmission to mobile stations;

a mobile station data selection unit that selects data regarding the mobile stations for simultaneous transmission from among data  
15 regarding all of the mobile stations based on the downlink investigation information received from the downlink investigation information generation unit;

a basis multiplication unit that performs matrix-multiplication and summation on the data regarding the mobile stations for simultaneous  
20 transmission, which are selected by the mobile station data selection unit, and the downlink investigation information, and outputs the results as data signals; and

an addition unit that adds pilot channel signals to the data signals and downlink investigation information, and outputs the added results,

25 wherein the added results are transmitted in units of a frame through the base station antennas to the mobile stations.

5. The mobile communication apparatus of claim 4, wherein the base station further comprises a mobile station fairness control unit  
30 that generates mobile station fairness information and outputs the mobile

station fairness information to the downlink investigation information generation unit.

6. The mobile communication apparatus of claim 4, wherein
- 5 the downlink investigation information generation unit comprises:
- a multiplication portion that generates channel information by multiplying the restored weight information and channel status information received from the feedback information restoration unit;
  - an index setting portion that indices all possible combinations of

10 the mobile stations;

  - a sub-part combination portion that combine the channel information into sub-parts with reference to the indices assigned by the index setting portion;
  - a mutual weight information generation portion that generates

15 mutual weight information based on the results of the combination performed in the sub-part combination portion;  - a channel capacity calculation portion that calculate transmission channel capacities based on the results of the combination received from the sub-part combination portion and the mutual weight information

20 received from the mutual weight information generation portion;

  - a storage portion that stores the transmission channel capacities regarding all of the mobile stations, which are output from the channel capacity calculation portion, the mutual weight information output from the mutual weight information generation portion, and the indices

25 received from the index setting portion; and

  - a maximum values search unit that compares the transmission channel capacities stored in the storage portion and extract indices that correspond to the maximum transmission channel capacity.

- 30 7. The mobile communication apparatus of claim 5, wherein

the downlink investigation information generation unit comprises:

a multiplication portion that generates channel information by multiplying the restored weight information and channel status information received from the feedback information restoration unit;

5        an index setting portion that indices all possible combinations of the mobile stations;

a sub-part combination portion that combine the channel information and mobile station fairness information into sub-parts with reference to the indices assigned by the index setting portion;

10       a mutual weight information generation portion that generates mutual weight information based on the results of the combination performed in the sub-part combination portion;

a channel capacity calculation portion that calculate transmission channel capacities based on the results of the combination received from  
15 the sub-part combination portion and the mutual weight information received from the mutual weight information generation portion;

a storage portion that stores the transmission channel capacities regarding all of the mobile stations, which are output from the channel capacity calculation portion, the mutual weight information output from  
20 the mutual weight information generation portion, and the indices received from the index setting portion; and

a maximum values search unit that compares the transmission channel capacities stored in the storage portion and extract indices that correspond to the maximum transmission channel capacity.

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8.       The mobile communication apparatus of claim 4 or 5, wherein the mutual weight information is quantized to a degree that is suitable to be fed back and then provided to the channel capacity calculation portion.

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9. A mobile communication apparatus with multiple base station/mobile station antennas, the apparatus including a base station and at least two mobile stations, comprising:

the base station restoring weight information and channel status  
5 information from feedback signals received from the mobile stations,  
determining downlink investigation information that results in maximum  
transmission channel capacity based on the restored weight information  
and channel status information, selecting mobile stations for  
10 simultaneous transmission from among all of the mobile stations based  
on the downlink investigation information, determining downlink tracking  
information based on the channel downlink investigation information and  
restored weight information and channel status information regarding the  
selected mobile stations, and processing data to be transmitted to the  
15 selected mobile stations based on the downlink tracking information,  
wherein the base station includes at least two base station antennas and  
each of the mobile stations includes at least one mobile station antenna.

10. The mobile communication apparatus of claim 9, wherein  
the maximum transmission channel capacity is calculated in  
20 consideration of packet fairness between the mobile stations.

11. The mobile communication apparatus of claim 9, wherein  
each of the mobile stations measures downlink characteristics of multiple  
base station/mobile station antenna channels based on pilot channel  
25 signals transmitted from the base station, determines the weight  
information and channel status information based on the downlink  
characteristics, converts the determined weight information and channel  
status information into the feedback signals, transmits the feedback  
signals to the base station, and detects high-speed downlink shared  
30 channel (HS-DSCH) signals in units of a frame based on the downlink

characteristics, and a first control signal and data signals, which are transmitted from the base station.

12. The mobile communication apparatus of claim 9, wherein  
5 the base station comprises:

a feedback information restoration unit that restores the weight information and channel status information received from each of the mobile stations through the base station antennas and outputs the restored weight information and channel status information;

10 a downlink investigation information generation unit that generates the downlink investigation information based on the restored weight information and channel status information in an investigation section prior to packet transmission to mobile stations;

15 a downlink tracking information generation unit that generates the downlink tracking information based on the restored weight information and channel status information and the downlink investigation information received from the downlink investigation information generation unit in a tracking section for packet transmission to the mobile stations;

20 a mobile station data selection unit that selects data regarding the mobile stations for simultaneous transmission from among data regarding all of the mobile stations based on the downlink investigation information received from the downlink investigation information generation unit;

25 a basis multiplication unit that performs matrix-multiplication and summation on the data regarding the mobile stations for simultaneous transmission, which are selected by the mobile station data selection unit, and the downlink tracking information output from the downlink tracking information generation unit, and outputs the results as data signals; and

30 an addition unit that adds pilot channel signals to the data signals

and downlink investigation information, and outputs the added results,  
wherein the added results are transmitted in units of a frame  
through the base station antennas to the mobile stations.

5           13.    The mobile communication apparatus of claim 12, wherein  
the base station further comprises a mobile station fairness control unit  
that generates mobile station fairness information and outputs the mobile  
station fairness information to the downlink investigation information  
generation unit.

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14.    The mobile communication apparatus of claim 12, wherein  
the downlink investigation information generation unit comprises:  
a multiplication portion that generates channel information by  
multiplying the restored weight information and channel status  
15 information received from the feedback information restoration unit;  
an index setting portion that indices all possible combinations of  
the mobile stations;  
a sub-part combination portion that combine the channel  
information into sub-parts with reference to the indices assigned by the  
20 index setting portion;  
a mutual weight information generation portion that generates  
mutual weight information based on the results of the combination  
performed in the sub-part combination portion;  
a channel capacity calculation portion that calculates transmission  
25 channel capacities based on the results of the combination received from  
the sub-part combination portion and the mutual weight information  
received from the mutual weight information generation portion;  
a storage portion that stores the transmission channel capacities  
regarding all of the mobile stations, which are output from the channel  
30 capacity calculation portion, the mutual weight information output from

the mutual weight information generation portion; and the indices received from the index setting portion; and

5 a maximum values search unit that compares the transmission channel capacities stored in the storage portion and extract indices that correspond to the maximum transmission channel capacity.

15. The mobile communication apparatus of claim 13, wherein the downlink investigation information generation unit comprises:

10 a multiplication portion that generates channel information by multiplying the restored weight information and channel status information received from the feedback information restoration unit;

an index setting portion that indices all possible combinations of the mobile stations;

15 a sub-part combination portion that combine the channel information and mobile station fairness information into sub-parts with reference to the indices assigned by the index setting portion;

a mutual weight information generation portion that generates mutual weight information based on the results of the combination performed in the sub-part combination portion;

20 a channel capacity calculation portion that calculates transmission channel capacities based on the results of the combination received from the sub-part combination portion and the mutual weight information received from the mutual weight information generation portion;

25 a storage portion that stores the transmission channel capacities regarding all of the mobile stations, which are output from the channel capacity calculation portion, the mutual weight information output from the mutual weight information generation portion, and the indices received from the index setting portion; and

30 a maximum values search unit that compares the transmission channel capacities stored in the storage portion and extract indices that



correspond to the maximum transmission channel capacity.

16. The mobile communication apparatus of claim 14 or 15, wherein the mutual weight information is quantized to a degree that is  
5 suitable to be fed back and then provided to the channel capacity calculation portion.

17. The mobile communication apparatus of claim 12, wherein the downlink tracking information generation unit comprises:  
10 a channel information sub-part selection portion that selects weight information and channel status information regarding mobile stations that correspond to the downlink investigation information received from the downlink investigation information generation unit from among the restored weight information and channel status information  
15 received from the feedback information restoration unit;  
a multiplication portion that multiplies the weight information and channel status information received from the channel information sub-part selection portion; and  
a mutual weight information generation portion that generates the  
20 downlink tracking information, which is mutual weight information, based on the product received from the multiplication portion.

18. The mobile communication apparatus of claim 17, wherein the mutual weight information is quantized to a degree that is suitable to  
25 be fed back.

19. The mobile communication apparatus of claim 3 or 11, wherein each of the mobile stations comprises:  
a channel characteristics measurement unit that measures the  
30 downlink characteristics based on the pilot channel signals received

through the mobile station antenna;

a channel information determination unit that determines weight information and channel status information that maximizes transmission capacity based on the downlink characteristics, which are compressed to  
5 be fed back;

an information feedback unit that converts the weight information and channel status information received from the channel information determination unit into the feedback signals and transmits the feedback signals through the mobile station antenna to the base station;

10 a control information restoration unit that compensates for a distortion of the first control signal received from the base station based on the downlink characteristics and restores a second control signal from the distortion-compensated first control signal, the second control signal including information as to whether the data signals are from a desired  
15 basis matrix and information on the number of bits included;

a data information restoration unit that restores data information that is received from every basis from the data signals received from the base station and the downlink characteristics;

a data information selection unit that selects data information  
20 received from the desired basis matrix from among the data information received from all of the basis matrices in response to the second control signal, and outputs the selected data information; and

a data information combination unit that combines the selected data information received from the data information selection unit and  
25 outputs the combined results as the high-speed downlink shared channel (HS-DSCH) signals.

20. A method of mobile communications between a base station and at least two mobile stations, wherein the base station  
30 includes at least two base station antennas, and each of the mobile

stations includes at least one mobile station antenna, the method comprising (a) the base station restoring weight information and channel status information from feedback signals received from the mobile stations, determining downlink investigation information that results in  
5 maximum transmission channel capacity based on the restored weight information and channel status information, selecting mobile stations for simultaneous transmission from among all of the mobile stations based on the downlink investigation information, and processing data to be transmitted to the selected mobile stations based on the downlink  
10 investigation information.

21. A method of mobile communications between a base station and at least two mobile stations, wherein the base station includes at least two base station antennas, and each of the mobile  
15 stations includes at least one mobile station antenna, the method comprising (a) the base station restoring weight information and channel status information from feedback signals received from the mobile stations, determining downlink investigation information that results in maximum transmission channel capacity based on the restored weight  
20 information and channel status information, selecting mobile stations for simultaneous transmission from among all of the mobile stations based on the downlink investigation information, determining downlink tracking information based on the channel downlink investigation information and restored weight information and channel status information regarding the  
25 selected mobile stations, and processing data to be transmitted to the selected mobile stations based on the downlink tracking information.

22. The method of claim 20 or 21, further comprising (b) each  
of the mobile stations measuring downlink characteristics of multiple  
30 base station/mobile station antenna channels based on pilot channel

signals transmitted from the base station, determining the weight information and channel status information based on the downlink characteristics, converting the determined weight information and channel status information into the feedback signals, transmitting the  
5 feedback signals to the base station, and detecting high-speed downlink shared channel (HS-DSCH) signals in units of a frame based on the downlink characteristics, and a first control signal and data signals, which are transmitted from the base station.

10 23. The method of claim 20 or 21, wherein the maximum transmission channel capacity is calculated in consideration of packet fairness between the mobile stations.

24. The method of claim 20, wherein step (a) performed in the  
15 mobile station comprises:

(a1) restoring the weight information and channel status information received from each of the mobile stations through the base station antennas;

(a2) generating the downlink investigation information based on  
20 the restored weight information and channel status information;

(a3) selecting data regarding the mobile stations for simultaneous transmission from among data regarding all of the mobile stations based on the downlink investigation information;

(a4) performing matrix-multiplication and summation on the data  
25 regarding the mobile stations for simultaneous transmission and the downlink investigation information and determining the results as data signals; and

(a5) adding pilot channel signals to the data signals and downlink investigation information, and transmitting the added results in units of a  
30 frame through the base station antennas to the mobile stations.

25. The method of claim 24, wherein step (a) further comprises (a6) generating mobile station fairness information that is considered when generating the downlink investigation information.

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26. The method of claim 21, wherein step (a) performed in the base station comprises:

(a1) restoring the weight information and channel status information received from each of the mobile stations through the base station antennas;

(a2) generating the downlink investigation information based on the restored weight information and channel status information;

(a3) generating the downlink tracking information based on the downlink investigation information and the restored weight information and channel status information;

(a4) selecting data regarding the mobile stations for simultaneous transmission from among data regarding all of the mobile stations based on the downlink investigation information;

(a5) performing matrix-multiplication and summation on the data regarding the mobile stations for simultaneous transmission and the downlink tracking information, and determining the results as data signals; and

(a6) adding pilot channel signals to the data signals and downlink investigation information, and transmitting the added results in units of a frame through the base station antennas to the mobile stations.

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27. The method of claim 26, wherein step (a) further comprises (a7) generating mobile station fairness information that is considered when generating the downlink investigation information.

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